WO 2004/054719 PCT/EP2003/014253

# CENTRIFUGE, PARTICULARLY A SEPARATOR, HAVING SOLIDS DISCHARGE NOZZLES AND WEAR PROTECTION

**[0001]** The invention relates to a centrifuge, particularly a separator, comprising a centrifugal basket having a basket shell which is provided with solids discharge nozzles.

**[0002]** A separator of this type is known from U.S. Patent Document US 3,108,952. In the exterior wall of the centrifugal basket of this separator, solids discharge nozzles are arranged in a mutually angularly offset manner in the area of the largest inside diameter of the centrifugal basket. In this case, nozzle bodies are inserted into bores of the basket shell, which nozzle bodies do not extend radially toward the outside but are oriented in an inclined manner with respect to the respective radial direction in order to utilize the acceleration effect of the product phase exiting from the nozzles, which reduces the power required for rotating the centrifugal basket.

**[0003]** Since the discharge nozzles are arranged in an inclined manner with respect to the radial direction, the product jet exiting from the discharge nozzles can at least by means of a certain portion impact on the exterior wall of the basket or collide with it, which may cause considerable wear of the exterior wall of the basket.

**[0004]** A similar state of the art is illustrated in U.S. Patent Document US 2,695,748. The discharge nozzles illustrated in this document each consist of a first sleeve with a bore extending centrically through the sleeve from the inside radially to the outside. The first sleeves are inserted into the bores of the basket shell. A second sleeve is in each case screwed into them in their end area at an angle with respect to the radial direction, which second sleeve also has a centric bore, so that the product phase exiting from the centrifugal basket is first guided through the first sleeve radially toward the outside and is then guided through the second sleeve from which it **(? wrong pronoun in the German)** exits in an inclined manner with respect to the radial direction the rotating direction of the separator.

**[0005]** From Figure 9 of U.S. Patent Document US 2,695,748 of the above-mentioned type, it is also known to insert the first sleeve at an angle with respect to the radial direction in a bore of the basket wall. In this case, at its outer end, the sleeve ends approximately flush with the exterior side of the centrifugal basket, which has the effect

that, behind the outlet of the sleeve with the nozzle, the product flow in a recess of the centrifugal basket can impact against the basket shell and can wear out the latter. In practice, the wear results in deep grooves in the basket wall which finally result in expensive maintenance work. For fixing the first sleeve on the centrifugal basket, a projection is used which locks into a groove of the centrifugal basket.

**[0006]** With respect to the state of the art, German Patent Documents DE 11 30 371 B, DE 199 51 663 A, DE 41 05 412 A, DE 18 61 982 U, DE 18 61 982 U **(same as previous document?)**, DD 42343 and U.S. Patent Document 20 60 239 are also mentioned which, however, are not as close to the invention.

**[0007]** It is an object of the invention to protect to separator of the above-mentioned type in a simple manner better than in the prior art against a wear caused by the product phase exiting from the solids nozzles.

**[0008]** The invention solves this task by means of the object of Claim 1. Accordingly, at least one wear protection device respectively is in each case arranged and/or constructed on the basket shell in the area of the solids discharge nozzles, which wear protection device reduces the wear in a simple manner.

**[0009]** According to a variant, the wear protection devices are constructed as wear protection elements. Separate elements permit an optimal adaptation to the task of the wear protection.

**[00010]** According to another variant, the wear protection devices are constructed as coatings, particularly of a ramp, in the basket shell. This variant represents an effective and, under certain circumstances, a lower-cost alternative to the separate wear protection elements.

**[00011]** The wear protection devices preferably consist of a wear-resistant material, such as steel or a hard metal or a ceramic material or a combination or a composite of these materials, or they are coated with such a material.

**[00012]** The discharge nozzles are preferably provided with discharge openings oriented at an angle á + â in an inclined manner with respect to the radial direction, and the angle á + â between the radial direction in the area of the discharge nozzles and the orientation of the discharge openings is preferably equal to or smaller than 90° (for example, between 70 and 85°). Since, specifically in the case of separators with such discharge nozzles, high wear of the basket shell occurs locally, the wear protection elements are particularly advantageous here. In this case, the orientation angle of the discharge openings with respect to the radial direction (R) particularly preferably amounts to between 70 and 90°.

**[00013]** The invention is suitable mainly for separators whose centrifugal basket has a vertical axis of rotation and has a single or double conical construction, the solids discharge nozzles preferably being arranged in the area of the largest diameter of the centrifugal basket, particularly being inserted in the latter from the outside.

**[00014]** Particularly advantageously, the invention can be used in the case of separators whose discharge openings are arranged offset toward the interior by a distance relative to the largest outer periphery or outside diameter of the centrifugal basket and which each have a recess as an extension of the discharge openings in the basket shell, which receive the wear protection elements.

**[00015]** In a particularly preferable manner, the wear protection elements extend from the discharge openings to the outer edge of the basket shell in order to protect specifically the latter area of the centrifugal basket which, according to the state of the art, is particularly stressed.

**[00016]** In the following, embodiments will be described in detail by means of the drawing also illustrating additional advantages of the invention.

**[00017]** Figures 1a, b are a sectional view of a section of the exterior wall of a centrifugal basket of a separator in the area of a solids discharge nozzle and a top view of the area of the solids discharge nozzle;

**[00018]** Figures 2a, b are two different views of the wear protection elements of the separator of Figure 1;

**[00019]** Figures 3a, b are analogous representations of a section of a second separator;

**[00020]** Figure 4 contains two different views of the wear protection elements of the separator of Figure 3;

**[00021]** Figures 5 a, b, c are representations analogous to Figures 1 and 2 of a section of a third separator;

**[00022]** Figures 6 a, b, c are representations analogous to Figure(s) 1 and **(2?)** of a section of a fourth separator; and

**[00023]** Figures 7 a, b, c and 8 are representations analogous to Figures 1 and 2 of a section of a fifth and sixth separator;

**[00024]** Figure 9 is a perspective view of a separator basket; and

**[00025]** Figure 10 is a lateral view of a section of the separator basket of Figure 9.

**[00026]** Figure 1 illustrates a portion of a sectional view of the basket shell 1 of a centrifugal basket of a separator with a perpendicular axis of rotation and, for example, a single-cone or double-cone geometry, which is equipped with at least one, preferable more

discharge nozzles 2 for solids.

**[00027]** The discharge nozzles 2 are formed of a sleeve body 3 and are each inserted (for example, screwed) in the radial direction of the centrifugal basket into bores 4 in the basket shell 1 which, in this case, also extend in the radial direction. On their outer periphery, the discharge nozzles 2 have sealing rings 22. Here, the basket shell has recesses 21 on the inside in each case in front of the discharge nozzles 2, which recesses 21 taper in the direction of the discharge nozzles 2 and guide the solids to the discharge nozzles 2.

**[00028]** The discharge nozzles 2 are each provided with a centric bore 7 which extends from the interior space 5 of the basket in the direction of the exterior space 6 of the basket and which extends in a first bore section 8 with a first diameter D1 in the radial direction from the interior to the exterior and then changes to a bore section 9 which is oriented at an angle with respect to the first bore section 8 and has a smaller diameter D2 relative to the first diameter.

**[00029]** In this manner, the discharge opening 10 of the bore section 9 is in each case oriented at an angle with respect to the radial direction R, the angle á + â between the radial direction R and the discharge opening 10 or the second bore area 9 preferably being equal to or smaller than 90°. In particular, it amounts to between 70 and 90°.

**[00030]** Since, on the outside, the sleeve bodies 3 end essentially flush with the outer edge of the basket shell 1, the discharge opening 10 is in each case offset toward the interior by a distance a relative to the largest outer periphery or outside diameter of the centrifugal basket 28 or of the basket shell.

**[00031]** Correspondingly, as an extension of the second bore section 9, a channel-type indentation or recess 11, which is constructed at an angle with respect to the radial direction, has to be constructed in the basket shell 1, so that the product phase exiting from the discharge nozzles 2 sprays as completely as possible on the outside past the basket shell 1.

**[00032]** However, in the case of this construction, a portion of the solids exiting from the discharge nozzle 2 impacts on the basket shell 1 and causes wear of the basket shell, particularly in the exterior area of the recess 11 as well as also farther in the peripheral direction.

**[00033]** In order to reduce or even avoid this wearing effect, it is provided to insert one wear protection element 12 respectively into the recesses 11, which is constructed separately from the discharge nozzles 10 and preferably extends from the discharge

openings 10 or from shortly behind the discharge openings 10 to the outer periphery of the basket shell 1 or beyond.

**[00034]** In an advantageous and easily producible manner, the wear protection elements 12 are constructed as plate-type bodies which, on the side which is on the exterior in the mounted position, are each themselves provided with a type of groove or channel 13 which, in the mounted position of Figures 1 and 2, points toward the outside and is advantageously used as a guiding or discharge channel for the product phase exiting from the centrifugal basket 1 at an angle á + â with respect to the radial direction R.

**[00035]** The centrifugal basket is protected against wear by means of the wear protection elements 12 in the area of the recess 11 in a simple and nevertheless effective manner.

**[00036]** The mounting of the wear protection elements 12 on the basket shell 1 can take place by means of screws 14 and/or mutually corresponding groove and tongue elements between the basket shell 1 and the wear protection elements. Thus, it becomes possible to provide the wear protection element 12 with a type of base plate 17 molded on in one piece, whose exterior edges can be pushed as tongues 15, 16 into two mutually opposite channels (outlined in Figure 1b in a broken line) in the lateral base area of the recess 11.

**[00037]** The wear protection elements 12 can thereby easily be exchanged in the event of damage or wear. In this manner, under certain circumstances, the service life of the centrifugal basket per se can also be increased. As special advantages, their easy handling and their basic suitability for retrofitting on existing centrifugal baskets should also be stressed.

**[00038]** The base of the semicylindrical channel 13 is offset by a distance b (in Figure 1, it corresponds to the distance x) toward the rear with respect to the discharge opening 10 of the discharge nozzle 11. In this case, the channel 13 can completely or in sections be oriented parallel or at an angle, which is smaller than 30°, particularly smaller than 20°, with respect to the second bore section 9 or with respect to the discharge opening 10.

**[00039]** A first area 18 of the channel 13 preferably adjoins the discharge opening 10 parallel to the second bore section 9, whose orientation at an angle á + â smaller than 90° (here approximately 80°, preferably between 70 and 85°) inclined with respect to the radial direction also defines the discharge angle of the product phase from the centrifugal basket; and a second area 19 is oriented slightly farther toward the radial direction (angle â), so that, in the end area of the channel 13, a type of ramp 20 is created which has a maximal height x over the base of the channel 13, which directs the portion of the product flow impacting here slightly farther radially toward the outside and in this manner has a slight

braking effect on this portion of the product flow, which may be advantageous in the operation of the separator.

**[00040]** The wear protection elements 12 are suitable for sleeve bodies 3 of the type of Figure 1 which, in the interior, close off flush with the interior side of the basket shell 1, as well as for sleeve bodies 3 which, in the manner of Figure 3, project slightly into the interior of the centrifugal basket 1, so that deposits can form around the sleeve bodies 3 which, in the case of certain products, may have an advantageous effect on the product processing.

**[00041]** In Figures 1 and 3, the wear protection elements 12 extend from the discharge openings 10 to the outer edge of the recesses 11, so that the entire area of the recesses is protected against wear.

**[00042]** As break edges, the ramps 20 extend in the longitudinal direction of the channel over less than half its length, particularly over a distance of up to 20 mm, according to a preferred variant, even only over a distance of from 1 to 5 mm. The height x (here, in Figure 1, x = b) of these edges or of the ramps preferably also amounts to 1 - 10 mm. With respect to the precise dimensioning, it is recommended that the influence of the diameter of the basket be taken into account.

**[00043]** The base of the channel 13 is preferably situated closely below the discharge opening 10. The distance between the discharge opening and the base of the channel - as well as their diameter - may influence the type and manner of the product flow discharge. In Figure 3, the height x is clearly lower than the distance b, so that the solids partially flow directly over the edge of the ramp 20. In addition, the length of the wear protection elements 20 in the peripheral direction is also shorter than in Figure 1.

**[00044]** The geometry of the transition between the ramp 20 and the remaining channel 13 may be curved or abrupt. It may also follow the geometry of a trigonometric or exponential function. Preferably, the inclination of the ramp with respect to the discharge direction of the solids increases away from the discharge opening.

**[00045]** As an extension of the channel, the geometry of the wear protection elements 12 is adapted to the curvature of the basket shell 1 in order to also ensure a protection here.

**[00046]** According to the embodiment of Figure 5, the ramps 20 project radially toward the outside beyond the outer periphery or the largest diameter of the centrifugal basket, which guides the product flow still farther toward the outside and contributes to preventing that the latter can come in contact with the basket shell. Virtually, a type of undercut 23 or an undercut break edge is formed.

**[00047]** Furthermore, the ramps are constructed according to Figure 5 virtually in the manner of a "ski jump"; that is, they have an angle á > 0 with respect to the discharge direction of the product flow from the nozzle 10 in a first area 24, and in the adjoining additional area 25, have a larger angle á + c (á>0; c>0) with respect to the discharge direction of the product flow from the nozzle 3.

**[00048]** An analogous situation applies to Figure 6. However, here the ramps project still farther beyond the outer periphery of the basket or the diameter toward the outside.

**[00049]** Figure 9 is a perspective view of a centrifuge according to the type of Figure 1. The double-cone geometry of the centrifugal basket or of the basket shell 1 with the bores 4 in the area of the largest diameter or in the area of the transition from the lower conical section to the upper conical section of the basket shell 1 is particularly visible, the discharge nozzles 2 or the sleeve bodies 3 having an external thread, so that they can be screwed from the outside into the bores 4 with a corresponding internal thread. The separately constructed wear protection elements 12 with their groove or channel are also easily recognizable. One of the wear protection elements respectively is provided behind each discharge nozzle in the rotating direction. Figure 10 is a corresponding lateral view of the centrifugal basket or of the basket shell 1.

**[00050]** According to Figures 7 and 8, no wear protection element 12 is constructed on the basket shell. Instead, a type of ramp 26 is constructed at the base of the recess 11 in the basket shell itself so that the product flow is directed farther radially toward the outside. This also reduces the wear problem because at least the entire basket shell is no longer detrimentally affected. The ramp 26 is preferably coated with a wear protection alloy (for example, with a hard metal or a titanium alloy).

**[00051]** In Figures 7 and 8, the measure of Figure 7 is also promoted in that the nozzle body 3 itself projects in a ramp-type manner beyond the outer periphery of the basket shell toward the outside and forms a type of ramp 27, so that, during the operation, it itself provides a certain deflection of the product flow discharged from the respective preceding nozzle.

**[00052]** Although the variants of Figures 8 and 8 do not offer a wear protection which is as optimal as that of the variants of the preceding figures, they can be implemented in a more favorable manner.

**[00053]** Reference Symbols

| | |
|---|---|
| Basket shell | 1 |
| discharge nozzles | 2 |
| sleeve body | 3 |
| bores | 4 |
| basket interior | 5 |
| basket exterior | 6 |
| bore | 7 |
| bore sections | 8,9 |
| discharge opening | 10 |
| recess | 11 |
| wear protection elements | 12 |
| groove | 13 |
| screws | 14 |
| tongues | 15, 16 |
| base plate | 17 |
| areas | 18,19 |
| ramp | 20 |
| recesses | 21 |
| sealing rings | 22 |
| undercut | 23 |
| areas | 24,25 |
| ramps | 26,27 |
| basket | 28 |
| diameter | D1, D2 |
| radial direction | R |
| distance | a,b,x |
| angle | á,â,c |